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RESEARCH

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Prioritizing circulation over airway to improve survival in trauma patients with exsanguinating injuries: a world society of emergency surgery-panamerican trauma consensus statement

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Abstract

Introduction Hemorrhage is one of the leading causes of preventable death in trauma patients. For decades, the Airway-Breathing-Circulation (ABC) approach has been the cornerstone of trauma care. However, emerging evidence suggests that prioritizing airway management in exsanguinating patients may worsen hypotension and increase mortality. This systematic review and meta-analysis aim to evaluate the effectiveness of the Circulation-Airway-Breathing (CAB) approach compared to the traditional ABC sequence in improving survival in trauma patients with severe hemorrhage.

Methods A systematic review was conducted in accordance with the PRISMA guidelines. Databases including PubMed and Ovid MEDLINE, SCOPUS, web of science and EMBASE were searched for studies published up to September 2024. Eligible studies included observational and comparative studies reporting outcomes of trauma patients with exsanguinating hemorrhage. The Newcastle–Ottawa Scale was used for risk of bias assessment. A meta-analysis

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was performed using a random-effects model to calculate pooled odds ratios (OR) for mortality, with 95% confidence intervals (CI). Subgroup analysis was conducted to compare the ABC and CAB approaches in prospective and retrospective studies.

Results Six studies (*N* = 11,855 patients) met the inclusion criteria. The meta-analysis revealed a significant increase in mortality associated with the ABC approach (pooled OR: 3.65, 95% CI: 1.74–7.65). Subgroup analysis of prospective cohort studies found an even higher mortality risk (POR: 9.99, 95% CI: 5.59–17.85) when compared with POR of retrospective studies (POR: 2.42, 95%CI: 1.08–5.36). High heterogeneity (I2 = 92%) was observed across the studies, likely due to variations in patient populations and resuscitation protocols.

Conclusion Prioritizing circulation over airway management in trauma patients with exsanguinating injuries significantly reduces mortality compared to the traditional ABC approach. The present consensus paper, conducted according to the WSES methodology[3], aims to provide a review of the literature comparing the CAB approach to the traditional ABC sequence in trauma patients with exsanguinating hemorrhage, to develop a shared consensus statement based on the currently available evidence

Introduction

Hemorrhage remains one of the leading causes of preventable death in trauma patients. For decades, trauma care has adhered to the well-established Airway, Breathing, Circulation (ABC) approach [1]. However, emerging evidence suggests this sequence may not be optimal for patients in hemorrhagic shock [2]. Prioritizing airway management before addressing circulation may worsen hypotension and lead to poorer outcomes. In patients with exsanguinating injuries, survival hinges on the body's ability to vasoconstrict and redistribute blood flow to vital organs such as the brain and heart. However, interventions such as induction for intubation, sedation, and positive pressure ventilation can disrupt these protective physiological mechanisms, leading to vasodilation, decreased cardiac function, reduced venous return, and potentially cardiovascular collapse, increasing mortality risk. Moreover, the use of rapid sequence intubation (RSI) with paralytics may eliminate the tamponade effect on muscles around bleeding sites, such as in the abdomen, neck, or junctional areas, further exacerbating bleeding [2].

Recent studies advocate revising the traditional sequence of care to prioritize circulation—from ABC to Circulation-Airway-Breathing (CAB) approach, or XABCs, with the"X"representing exsanguination. This approach focuses on hemorrhage control and resuscitation as the first step, before airway management with endotracheal intubation. Early results from both civilian and military trauma settings show that this shift could lead to improved survival rates and fewer complications, particularly in patients with severe exsanguinating hemorrhage [2].

This systematic review with meta-analysis compares the CAB approach to the traditional ABC sequence in trauma patients with exsanguinating hemorrhage. By analyzing survival rates, we aim to determine whether CAB provides a measurable benefit over ABC in improving patient outcomes.

Project rationale and design

The present consensus paper, conducted according to the WSES methodology [3], aims to provide a review of the literature comparing the CAB approach to the traditional ABC sequence in trauma patients with exsanguinating hemorrhage, to develop a shared consensus statement based on the currently available evidence. A panel of international experts was selected to draft the paper and the recommendations. The international panel was asked to critically revise and discuss the manuscript to develop the statements. The final grade of the statement was assessed according to the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) system [4].

Purpose and use of this consensus

This consensus statement evidence-based, with the grades of recommendation based on the current scientific evidence and a consensus of experts. These recommendations do not exclude other approaches as being within a standard of practice. The treating clinician should determine the most appropriate action, after considering conditions at the relevant medical institution (staff levels, experience, equipment, etc.) and the characteristics of the individual patient. The responsibility for the management and outcome rests with the engaging practitioners, and not the consensus group.

Methods

This systematic review with meta-analysis was conducted to analyze the evidence for prioritizing circulation (i.e., hemorrhage control, blood product administration) in

the resuscitation of trauma patients with exsanguinating injuries, focusing on outcomes such as survival and complications. We followed the Cochrane Collaboration's recommendations and guidelines for observational studies and the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) [5] statement. (Supplemental Table 1) This study was prospectively registered in PROSPERO, an international registry for systematic reviews (PROSPERO 2014; ID: CRD42024593897).

We utilized the GRADE (Grading of Recommendations, Assessment, Development, and Evaluation) methodology to assess the evidence's certainty and recommendations' strength. GRADE is a structured and transparent approach commonly used in systematic reviews and clinical guidelines. It focuses on framing questions, selecting important outcomes, evaluating the quality of evidence, and making informed recommendations based on the balance of benefits and harms. GRADE ensures a thorough and objective review process, providing clear insights into the strength of evidence used to formulate clinical decisions.

Study eligibility

The eligibility criteria were established using the Cochrane Population, Intervention, Comparison, Outcome (PICO) tool. The population of interest was trauma patients with exsanguinating hemorrhage. The intervention was the Circulation-Airway-Breathing (CAB) approach, and the comparison was the traditional Airway-Breathing-Circulation (ABC) approach. The outcomes of interest included in-hospital mortality and complications.

The inclusion criteria were:

1. Studies published in the English language, from January of 2000 to September 2024.
2. Observational (cohort, cross-sectional, case–control studies), and comparative studies with data on outcomes such as survival, achievement of hemodynamic stability, and complications.
3. Studies analyzing trauma patients who were hypotensive, hypovolemic, actively bleeding, and victims of severe trauma.
4. Studies reporting mortality or other patient outcomes with risk estimates for the meta-analysis.

The following studies were excluded from the systematic review and meta-analysis:

1. Review articles, commentaries, guidelines, letters, case reports, and editorials.
2. Conference presentations and non-peer-reviewed articles.
3. Studies with insufficient data on the prioritization of circulation in trauma resuscitation.
4. Studies focusing on non-traumatic bleeding (e.g., gastrointestinal, obstetric).
5. Animal studies.

Data source

We collaborated with an information retrieval specialist (Health Sciences Librarian initials: JP) to develop comprehensive search terms and strategies, incorporating correct search strings, Boolean operators and MeSH terms. Different MeSH terms in varying combinations were used for our searches, one example is as follows; ((((((("trauma centers"[MeSH Terms]) OR ("multiple trauma"[MeSH Terms])) AND (("trauma centers"[MeSH Terms]) OR ("multiple trauma"[MeSH Terms]))) AND ("hemorrhage"[MeSH Terms])) OR (exsanguinating hemorrhage[MeSH Terms])) AND ("resuscitation"[MeSH Terms])) AND ("mortality"[MeSH Terms]).

Table 1 Risk of Bias assessment by domain using Newcastle- Ottawa Scale for Observational studies (Cohort and cross-sectional studies) ($N = 6$)

Study	Study design	Selection* (Maximum 4–5 *)	Comparability (Maximum 2 *)	Outcome/ exposure (Maximum 3 *)
Dunton et al., 2023	Retrospective cohort	***	**	***
Ferrada, P. 2018	Cross-sectional	****	*	***
Ferrada et al., 2018	Retrospective cohort	***	*	***
Ferrada et al., 2024	Prospective cohort	****	**	***
Ritondale et al., 2024	Prospective Cohort (historical controls)	****	*	***
Taghavi et al., 2014	Retrospective cohort	***	**	***
		3.5	1.5	3

* (5 stars NOS scale for cross-sectional studies, 4 for cohort studies)

Initial search was conducted on Cochrane Central Register of Controlled Trials (CENTRAL) to identify any previously published meta-analyses on the topic. To include relevant published publication multiple searches on electronic databases including PubMed and Ovid MEDLINE, SCOPUS, Web of Science, and EMBASE from September 20, 2024, to September 25, 2024. A hand search of the reference lists of included articles supplemented this effort, and duplicates were manually removed.

Study selection

Two researchers (PF and SS) independently screened studies based on the pre-defined eligibility criteria to reduce selection bias. Full-text articles were retrieved for studies that met the requirements, and two reviewers screened each selection for agreement.

Data abstraction

Comprehensive spreadsheets were created in Microsoft Excel for Windows (version 2407). Variables such as study characteristics, population characteristics, outcomes, and risk estimates were extracted. Two researchers worked individually to ensure accuracy and compared data to reach 100% agreement, without conflict.

Risk of bias assessment

The Newcastle–Ottawa assessment (NOS) scale for observational studies was used to assess the quality of the included studies [6]. Two reviewers assessed the studies independently for any bias.

Statistical analysis

A qualitative analysis was performed on study characteristics, such as design, timeline, region, data source, sample size, patient characteristics, and outcomes. We used a random-effects model for quantitative analysis to summarize the results using MetaXL (version 5.3) [7, 8]. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated for mortality among hemorrhage patients. The sensitivity analysis examined each study's effect on the overall results. Additionally, exploratory sub-group analysis was performed to compare the risk across prospective and retrospective studies.

Multidisciplinary approach

This multidisciplinary group of international experts in trauma resuscitation included surgeons, advanced care providers (APPs), emergency medicine physicians, anesthesiologists, and emergency medical services personnel from countries such as the USA, Colombia, Bolivia, Brazil, Ecuador, Panama, Chile, Venezuela, Mexico, Paraguay, Guatemala, Italy, and Kenya. The group was convened to review the systematic review and meta-analysis findings and cast votes on the recommendations. By incorporating a wide range of expertise and perspectives, the panel ensured that the recommendations reflect global best practices and address trauma care challenges across various healthcare settings.

Results

Search results

Electronic and manual searches identified a total of 4,332 records. Of these, 57 records were reviewed in full, and 50 were excluded with reasons. Ultimately, six studies (N= 6) met the eligibility criteria and were included in this systematic review and meta-analysis. [9–14] Fig. 1.

Risk of bias assessment

NOS scales for cross-sectional and cohort studies were used to assess the risk of bias. Table 1 shows the overall- study-level risk of bias. The studies ranged from 7–9 stars, indicating a low to moderate risk of bias. Overall, a poor comparability scores were observed across studies.

Description of included studies

Of the six included studies, two were prospective and four were retrospective. Four studies were performed in the US, and two were collaboration between US and international trauma centers. The studies were published between 2014 and 2024, with data collection from 2006 to 2022. One study utilized data from the National Trauma Data Bank (NTDB), while the others used trauma registries or individual hospital records. (Table 2). Study populations (N= 11,855 patients) consisted of adults aged 16 years and older who presented with exsanguinating hemorrhage. Details on intervention/exposure, the comparison, and primary and secondary outcomes for each study are documented in Table 2. Most patients were male, with a mean age range of 28 to 44 years. Five studies were included in the meta-analysis; one study that reported prevalence for mortality only was excluded from the meta-analysis (Table 3).

Primary outcomes

The included studies reported odds ratios (ORs) for mortality, ranging from 1.1 (95%CI: 0.76–1.62) to 9.10 (95%CI: 4.30–20.0). The random-effects model yielded a pooled odds ratio (POR) of 3.65 (95%CI: 1.74–7.65),

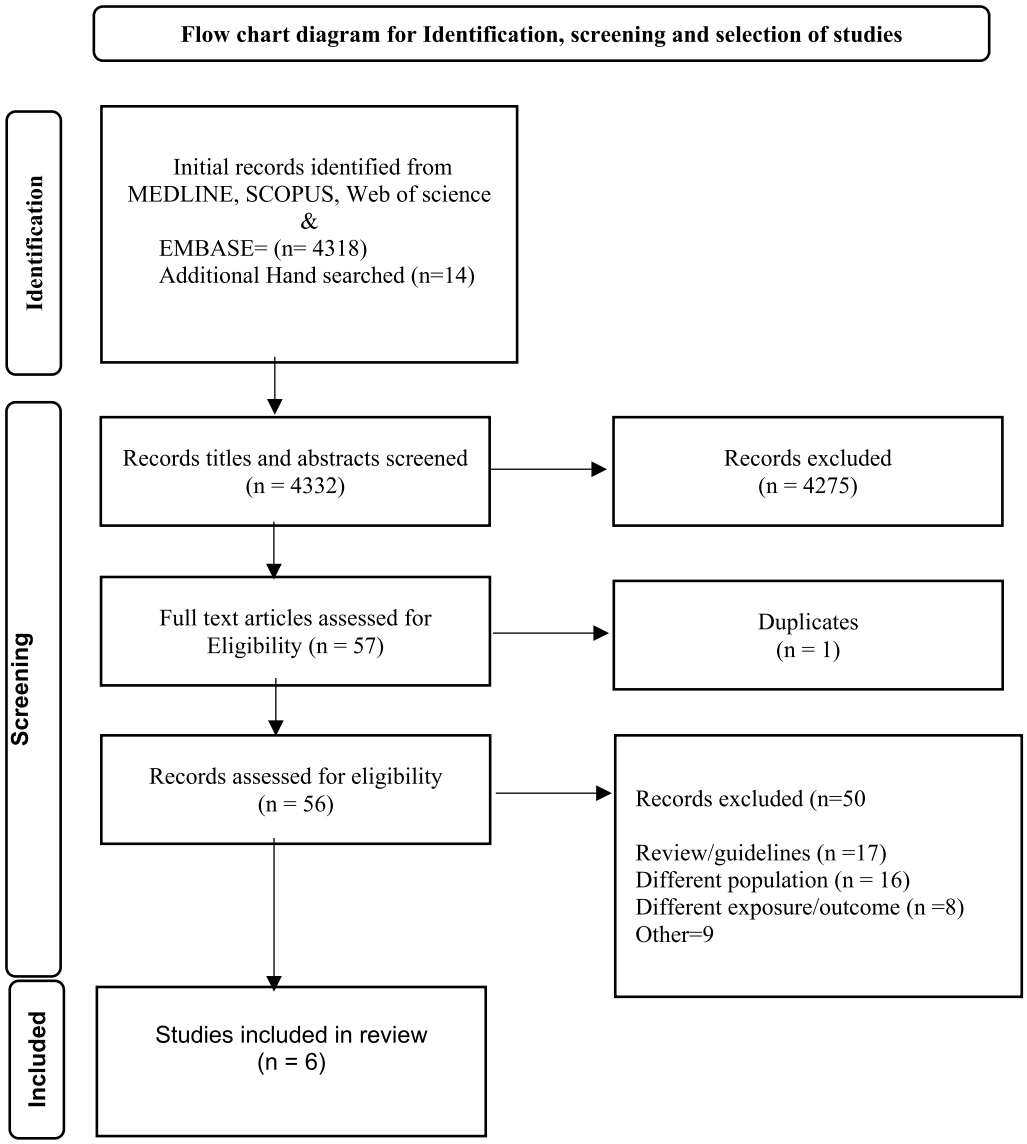
Flow chart diagram for Identification, screening and selection of studies
Identification
Initial records identified from MEDLINE, SCOPUS, Web of science & EMBASE= (n= 4318) Additional Hand searched (n=14)
Screening
Records titles and abstracts screened (n = 4332)
Records excluded (n = 4275)
Full text articles assessed for Eligibility (n = 57)
Duplicates (n = 1)
Records assessed for eligibility (n = 56)
Records excluded (n=50
Review/guidelines (n =17)
Different population (n = 16)
Different exposure/outcome (n =8)
Other=9
Included
Studies included in review (n = 6)

Fig. 1 Flow chart diagram describing the identification, screening, and selection of studies included in the systematic review and meta-analysis (SR and MA) for assessing the risk of mortality among exsanguinating hemorrhage patients in trauma, (n = 6 studies)

indicating a statistically significant increase in mortality with the ABC approach. (Table 4). Heterogeneity across studies was high (I [2] = 92%, $p < 0.001$). The sensitivity analysis confirmed the robustness of the results, with minor changes to the POR when individual studies were removed. (Table 5). The summary of the meta-analysis is shown in the Forest plot (Fig. 2). The sub-group analysis with prospective cohort studies comparing ABC with CAB (n = 2) [12, 13], found a higher magnitude of risk for mortality (POR:9.99, 95%CI: 5.59–17.85). (Table 6, Fig. 3a), when compared to retrospective studies (n = 3) [9, 11, 14], POR:2.42, 95%CI: 1.08–5.36. (Table 7, Fig. 3b).

Discussion

This comprehensive systematic review and meta-analysis was conducted to evaluate the evidence supporting the prioritization of circulation during the resuscitation of trauma patients with exsanguinating hemorrhage and its effect on survival. The pooled data from eight studies [9–14] revealed a significant threefold increase in mortality risk for patients who were intubated first, highlighting the critical importance of addressing circulation early in the resuscitation process for patients with exsanguinating hemorrhage. An influence analysis further strengthened these findings, confirming the robustness of the

Table 2 Characteristics of the included studies (*N* = 6 studies)

Study	Region	Design	Data source	Data collection Period	Trauma center	Sample size (*N*)
a						
Dunton et al., 2023	US	Retrospective	NTDB	2017–19	Multicenter (*N* = 253), Level I, II	9667
Ferrada, P. 2018	US	Cross-sectional	Patient records	2014–15	Single center, Level I	66
Ferrada et al., 2018	International	Retrospective	Trauma records	2014–16	Multicenter (*N* = 12), level I	440
Ferrada et al., 2024	International	Prospective	Trauma records	2018–22	Multicenter (*N* = 6),	278
Ritondale et al., 2024	US	Prospective (historic controls)	Trauma registry	2016–19 (m. controls)	Single center	93
Taghavi et al., 2014	US	Retrospective	Trauma records	2006–10	Single center, Level I	1311

Study	Population	Intervention/Exposure	Comparison	Primary/secondary outcome
b				
Dunton et al., 2023	≥ 16, hemorrhage patients	ER intubation prior to hemorrhage control	OR intubation with hemorrhage control surgery	In-hospital mortality, complications (cardiac arrest)
Ferrada, P. 2018	Hypotensive patients	Intubation in hypotensive	No comparison group	Mortality
Ferrada et al., 2018	Hypovolemic shock	ABC	CAB	Mortality
Ferrada et al., 2024	Exsanguinating bleeding patients	ABC	CAB	24 h, 30 days mortality, ARDS, renal failure
Ritondale et al., 2024	Severe hemorrhage	ABC	x-ABC	In-hospital mortality
Taghavi et al., 2014	Penetrating Trauma (gunshot, stab wounds)	Prehospital intubation	No intubation	Mortality, Pulmonary complication, pulmonary embolus/thrombosis, sepsis, wound infections

SR with MA

Table 3 Patient demographic, clinical characteristics and outcomes. (*N* = 6 studies). SR with MA

Study	Age	Gender	Mechanism of injury	SBP	Mortality *N* (%)
Dunton et al., 2023	33 (24–26)	83%M	P: firearm (51%), stab (21%)	108[88–130]	ED intubation = 343 (17.4%) OR intubation = 544 (7.1%)
Ferrada, P. 2018	44 years	74%M	P: (33.6%)	< 90, mean drop = 18	35 = 53%
Ferrada et al., 2018	39(26–54)		P: (33.15%)	80[59–98], CAB = 80[50–95], ABC = 82[62–99]	49.1%, ABC = 50.0%, CAB = 47.7%
Ferrada et al., 2024	47(35,61)	87.77%M	B: (76.64%), P: (23.38)	73[64–81]	ABC = 69.2%, CAB = 11.1%
Ritondale et al., 2024	32(24–41)	97%M	Penetrating only	74[0–82]	23(37%) ABC = 15 (47%) x-ABC = 8(13%)
Taghavi et al., 2014	(int.)27.8 ± 10.5	(int.)96.4%M	Penetrating only, Gunshot = 89.1%	NR	Intubated = 29 (52.7%), Not intubated = 96(7.6%)

ABC: Airway, Breathing, Circulation, *CAB*, *P*: Penetrating trauma, *B*: Blunt trauma, *NR* = not reported

conclusions. Sub-group analysis including only the prospective studies [12, 13] showed an even higher mortality risk—tenfold—among patients treated with the traditional ABC approach compared to those treated with the CAB (Circulation, Airway, Breathing) method, emphasizing the life-saving potential of prioritizing circulation.

The overall analysis did, however, reveal high heterogeneity among the studies, which was likely due to variations in resuscitation strategies, study populations, and methodological differences. This variability highlights the inconsistencies in effect sizes across studies, partly due to small sample sizes and methodological discrepancies.

The concept of prioritizing circulation over airway in trauma resuscitation marks a significant paradigm shift in how we manage patients with exsanguinating hemorrhage. Historically, the ABC (Airway, Breathing, Circulation) sequence has been the cornerstone of trauma care. However, emerging evidence suggests that intubating first may worsen outcomes in patients with exsanguinating

Table 4 Individual (OR) and pooled effect size (POR) with 95% CI: meta-analysis of the risk of mortality among trauma patients (*N* = 5 studies)

Study	OR	LCI 95%	HCI 95%	Weight (%)
Dunton et al., 2023	1.85*	1.54	2.23	23.11
Ferrada etal.,2018	1.10	0.76	1.62	22.09
Ferrada et al., 2024	9.10*	4.30	20.0	18.71
Ritondale et al., 2024	6.32	2.27	17.60	16.17
Taghavi et al., 2014	8.26*	4.34	15.76	19.90
Pooled OR	**3.65**	**1.74**	**7.65**	100
Statistics				
I-squared	**91.769**	83.776	95.83	
Cochran's Q	48.596			
Chi2, *p*	<.001			
tau2	0.607			

The bold formatting is used to indicate statistical significance at *p* 0.05

* Adjusted ORs, adjusted for baseline demographic, and injury related characteristics (Studies reporting risk for mortality were included in MA, *N* = 5)

hemorrhage by exacerbating hypotension and compromising cardiac function [5–12].

Successful implementation of this paradigm shift requires a multidisciplinary approach. Surgeons, nurses, anesthesiologists, emergency medicine physicians, advanced care professionals (APPs), and emergency medical services (EMS) personnel must collaborate to ensure that circulation is prioritized from the scene and during the initial in-hospital management of trauma patients with exsanguinating hemorrhage.

Hemorrhage remains the leading cause of preventable death in both civilian and military trauma settings [15, 16]. Over the years, resuscitation science has advanced significantly with the introduction of damage-control resuscitation, focusing on early and balanced blood product administration, minimizing crystalloid use, addressing trauma-induced coagulopathy, and prioritizing rapid hemorrhage control [17–24]. Historically, these interventions were only available once patients arrived at the trauma center, but we now understand that time is of the essence for hemorrhaging patients. Deaths from

Table 5 Sensitivity analysis showing pooled Odds Ratio (POR) following removal of each eligible study from the meta-analysis (*N* = 5)

Excluded study	Pooled OR	LCI 95%	HCI 95%	Cochran Q	*p*	I^2	I^2 LCI 95%	I^2 HCI 95%
Dunton et al., 2023	4.650	1.311	16.495	45.268	< 0.001	93.373	86.237	96.809
Ferrada etal.,2018	5.239	1.886	14.554	36.462	< 0.001	91.772	82.112	96.216
Ferrada et al., 2024	2.907	1.390	6.081	33.337	< 0.001	91.001	80.052	95.940
Ritondale et al., 2024	3.282	1.469	7.329	43.762	< 0.001	93.145	85.663	96.772
Taghavi et al., 2014	2.895	1.408	5.952	29.278	< 0.001	89.753	76.632	95.507

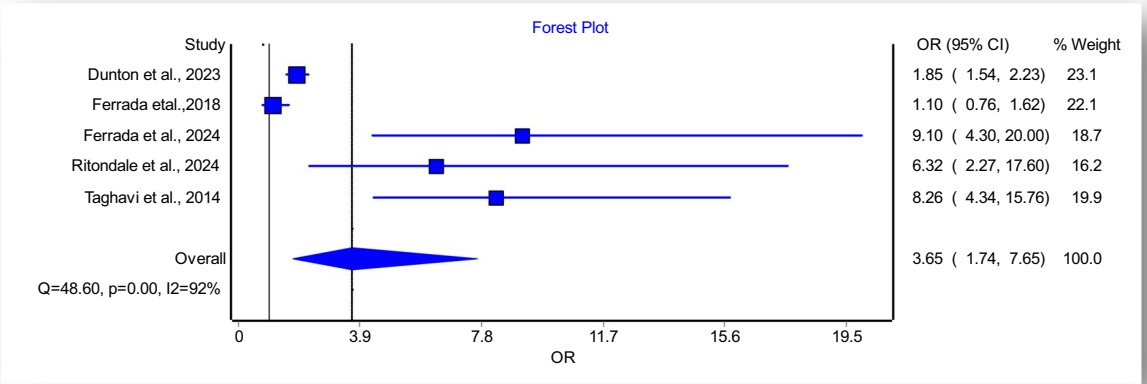

Fig. 2 Forest Plot with individual (OR) and pooled effect size (POR) with 95%CI and study' weights: meta-analysis of the risk of mortality among trauma patients (*N* = 5 studies)

Table 6 Exploratory sub-Group analysis with prospective cohort studies comparing the risk of mortality between ABC and CAB approach ($N = 2$)

Study	OR	LCI 95%	HCI 95%	weight (%)
Ferrada et al., 2024	12.1	6.5	22.4	70.549
Ritondale et al., 2024	6.32	2.27	17.6	29.450
Pooled OR	**9.99**	**5.593**	**17.853**	100
Statistics				
I-squared	**11.666**			
Cochran's Q	1.132			
Chi2, *p*	0.287			
tau2	0.0246			

The bold formatting is used to indicate statistical significance at *p* 0.05

exsanguinating hemorrhage often occur within the first few hours following injury, with a significant portion happening even before patients reach the hospital [15, 16]. This highlights the critical need to bring advanced hemorrhage control and resuscitation strategies into the prehospital environment, and sharing resuscitation strategies with first responders can improve outcomes for patients with exsanguinating hemorrhage.

For patients with severe traumatic brain injury (TBI), it is crucial to avoid hypoxia, as this strongly correlates with survival [16], and for these patients early intubation might be indicated. However, the traditional guideline to intubate trauma patients with a Glasgow Coma Scale (GCS) score of 9 or below should be reevaluated, particularly in cases of penetrating injuries where TBI is less likely [19–24]. In these patients with penetrating trauma and exsanguinating hemorrhage, a low GCS is often a result of inadequate brain perfusion rather than a neurological injury. For this group of patients, initiating early blood transfusion with whole blood is more beneficial than immediate intubation. While airway management should still take priority in cases of airway obstruction or severe hypoxia, focusing on restoring circulation in patients with exsanguinating hemorrhage, can lead to better outcomes.

Bleeding control is the first and most critical step in the"C"component of the CAB (, and it should be the primary focus in trauma management. Prioritizing hemorrhage control from the onset ensures better outcomes for patients experiencing severe blood loss. When managing exsanguinating hemorrhage, early whole blood resuscitation during transport, if available, is essential. Upon arrival at the trauma center, whole blood and component therapy at a ratio as close to 1:1:1 as possible should be prioritized over intubation [7–24]. This approach optimizes circulation, supports perfusion to critical organs, and increases the chances of survival. A definitive airway should only be secured after addressing the deficit in intravascular volume and ensuring adequate resuscitation efforts have been made.

This shift in practice represents a comprehensive, system-wide transformation in trauma care. Collaboration across medical disciplines is essential to ensure the consistent application of these advanced resuscitation techniques. Adopting a unified approach that prioritizes circulation could significantly reduce preventable deaths, improve survival rates in patients with exsanguinating hemorrhage, and optimize long-term outcomes.

Global collaboration is also key in promoting this paradigm shift, particularly in resource-limited environments where human and material resources may be scarce. In these settings, resuscitation may occur sequentially rather than simultaneously, making it even more crucial to clearly define and prioritize the resuscitation steps. By working together, international experts can share knowledge, refine guidelines, and ensure that life-saving innovations are accessible to all patients, regardless of location. This collective effort strengthens trauma care worldwide, allowing even the most resource-constrained regions to benefit from advancements in resuscitation practices.

This systematic review and meta-analysis advocate for a shift in trauma resuscitation practices, specifically prioritizing the treatment of life-threatening hemorrhage over airway management. In trauma, most preventable deaths are due to exsanguinating hemorrhage, making hemorrhage control the first and most critical step in saving lives. The current evidence supports the idea that for patients with exsanguinating hemorrhage, CAB (Circulation, Airway, Breathing) can be beneficial. Focusing on early hemorrhage control and whole blood resuscitation as the initial priority and prioritizing this resuscitation over intubation can result in better outcomes.

Limitations

Limitations of this study should be acknowledged, especially in relation to the methodology and study selection. Although randomized controlled trials (RCTs) are the gold standard for establishing causality and were included in the search criteria, no published RCTs on this topic are currently available. As a result, the analysis relied entirely on observational studies, which inherently carry the risk of potential selection bias. While efforts were made to adjust for these confounders, the non-randomized nature of the studies limits the ability to definitively conclude causality between the CAB approach and improved outcomes.

Second, the high heterogeneity observed in the meta-analysis indicates variability in the study designs, populations, and interventions. Differences in the trauma settings, injury severity, and care protocols could

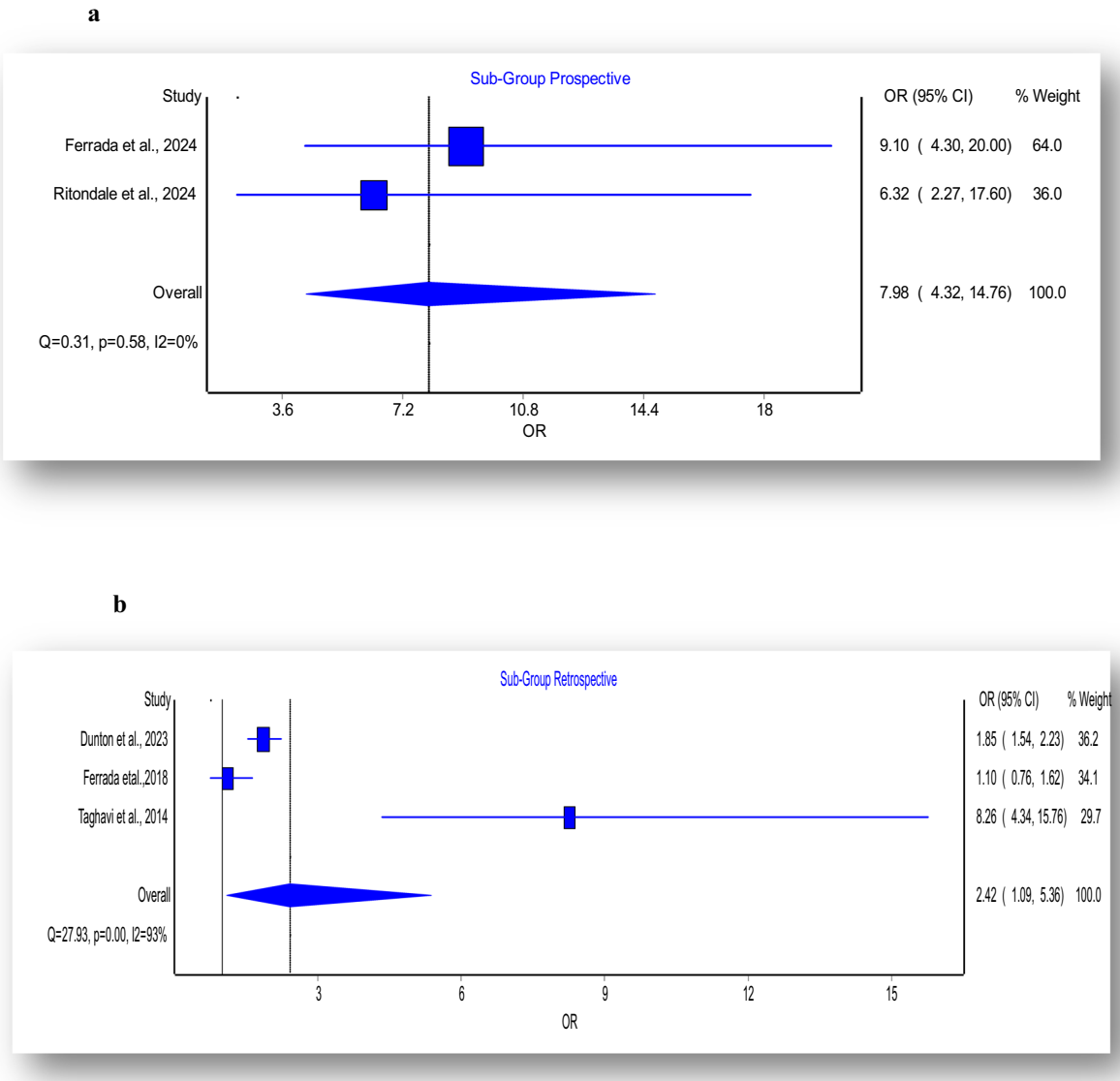

Fig. 3 **a** Forest plot for exploratory sub-group analysis with prospective cohort studies comparing the risk of mortality between ABC and CAB approach (*N* = 2). **b** Forest plot for exploratory sub-group analysis with retrospective cohort studies comparing the risk of mortality between ABC and CAB approach (*N* = 3)

influence the results, making it difficult to apply the findings universally. This heterogeneity also raises concerns about the generalizability of the findings to other populations or healthcare settings.

Third, due to a limited number of included studies, there is a potential for publication bias. Studies with non-significant or smaller effect sizes may not have been published or included, potentially skewing the results toward a more favorable outcome for the CAB approach.

Finally, many of the included studies had relatively small sample sizes, which could limit the precision of the effect estimates. Larger, well-designed, randomized controlled trials are necessary to validate the findings and establish stronger evidence for prioritizing circulation in trauma resuscitation.

Recommendations

The multidisciplinary group of global experts voted on the following recommendations, ensuring that insights from various fields and international perspectives were fully integrated into the final consensus.

Table 7 Exploratory sub-Group analysis with retrospective cohort studies comparing the risk of mortality between ABC and CAB approach ($N = 3$)

Study	OR	LCI 95%	HCI 95%	weight (%)
Dunton et al., 2023	1.85	1.54	2.23	36.194
Ferrada etal.,2018	1.1	0.76	1.62	34.077
Taghavi et al., 2014	8.26	4.34	15.76	29.729
Pooled OR	**2.42**	**1.089**	**5.364**	100
Statistics				
I-squared	**92.840**	**82.391**	**97.089**	
Cochran's Q	27.934			
Chi2, *p*	8.59E-07			
tau2	0.447			

The bold formatting is used to indicate statistical significance at *p* 0.05

(1) *Prioritize hemorrhage control over intubation*: The panel recommends to prioritize resuscitation and hemorrhage control before proceeding with invasive airway management in patients with exsanguinating hemorrhage. This approach significantly reduces mortality. This approach should be adopted in trauma scenarios where early and rapid hemorrhage control is critical to survival. Use of non-invasive airway management methods such as oral airways, bag valve mask ventilation and supplemental oxygen while concurrently improving circulation to vital organs with transfusion of blood and blood components needs to be prioritized in acute resuscitation. *(Grade of recommendation: strong recommendation, based on moderate quality evidence).*

(2) *Prehospital and emergency department protocols*: The panel recommends emergency medical services and trauma teams should be trained to focus on early hemorrhage control, resuscitation with blood products, and limiting unnecessary airway interventions that could potentially exacerbate hypotension in patients with exsanguinating hemorrhage OR significant hemorrhage. This will require a shift in prehospital and hospital protocols to ensure alignment with these principles. *(Grade of recommendation: strong recommendation; quality of evidence: moderate quality evidence)*

Conclusion

Prioritizing circulation over airway management in patients with exsanguinating hemorrhage is highly recommended, as it has the potential to significantly improve survival rates by reducing the risk of cardiovascular collapse. However, there are exceptions, such as cases of airway obstruction, where securing a definitive airway through intubation must take priority. In most cases, focusing on restoring circulating volume and early hemorrhage control leads to better outcomes. Randomized controlled trials (RCTs) are needed to establish causality and refine these protocols. Collaboration, training, and ongoing research will be crucial for successful implementation of these concepts on a global scale.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13017-025-00618-2.

Supplementary file 1.
Supplementary file 2.
Supplementary file 3.
Supplementary file 4.

Author contributions

Paula Ferrada and Saima Shafique performed the meta-analysis and systematic review. Paula Ferrada conceived the idea for the manuscript. All authors contributed to the development and writing of the manuscript. The leadership of the Panamerican Trauma Society and the World Society of Emergency Surgery reviewed the manuscript, suggested revisions, and agreed with the manuscript as a consensus statement.

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No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This is a consensus statement and does not require an ethics declaration. "Ethics declaration: Not applicable".

Competing interests

There are no competing interests or conflicts of interest to declare pertinent to this manuscript.

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